



Species

Fungal ecological niche of walking mango tree

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ABSTRACT

The variety and galaxy of fungi and their natural beauty occupy prime place in the biological world and India has been the cradle for such fungi. Fungi are not only beautiful but play a significant role in the daily life of human beings besides their utilization in industry, agriculture, medicine, food industry, textiles, bioremediation, natural cycling, as biofertilizers and many other ways. Fungal biotechnology has become an integral part of the human welfare. The extent of fungal diversity is reviewed, with respect to revised estimates of the numbers of plant species, and recent data is collected from Walking Mango Tree, Gujarat, India. No literature is available on the fungi species present in walking mango tree. In the present study, 88 species of fungi belonging to 10 Genera were isolated from various samples like stem, bark, leaf, fruit, soil and sap of walking mango tree, which were found to be *Aspergillus spp.*, *Cladosporium spp.*, *Cunninghamella sp.*, *Fusarium spp.*, *Helminthosporium spp.*, *Hypocrea spp.*, *Penicillium spp.*, *Pythium spp.* and *Syncephalastrum sp.*, *Trichoderma spp.* This study reveals the presence of a fungi present in this tree. Their endophytic association's needs to be further studied. Their manifestation in this highly acidic environment also needs to be worked out.

Keywords: Clotting agent, Uniqueness, Dicot Host, Endophytic association's

1. INTRODUCTION

'True' fungi are ubiquitous in the environment and fulfill a range of important ecological functions, particularly those associated with nutrient and carbon cycling processes in soil (Christensen, 1989). Despite this, our understanding of fungal community diversity and functioning remains poor relative to that of bacterial communities (Hattori et al., 1997). A major contributing factor has been the tendency of mycologists to rely upon culture-based methods in

Fungus

Any member of a kingdom of organisms (Fungi) that lack chlorophyll, leaves, true stems, and roots, reproduce by spores, and live as saprotrophs or parasites. The group includes moulds, mildews, rusts, yeasts, and mushroom.

Ecological Niche

The status of an organism within its environment and community (affecting its survival as a species).

Symbiont

An organism in a symbiotic relationship. In cases in which a distinction is made between two interacting organisms, the symbiont is the smaller of the two and is always a beneficiary in the relationship, while the larger organism is the host and may or may not derive a benefit.

Endophytic

An endophyte is an endosymbiont, often a bacterium or fungus that lives within a plant for at least part of its life without causing apparent disease.

Parasitism

A symbiotic relationship in which one organism (the parasite) benefits and the other (the host) is generally harmed. Parasites derive nutrition from their host and may also gain other benefits such as shelter and a habitat in which to grow and reproduce.

ecological investigations of fungi. The limitations of these approaches have frequently been highlighted, and the data provide only a selective, and invariably biased, window on diversity. Fungi are cryptic, understudied and hyperdiverse organisms. Fungi are eukaryotic organisms that cannot produce their own energy and depend on enzymatic processes to break down biopolymers that are then absorbed for nutrition. The kingdom *Fungi* encompasses tremendous biological diversity, with members spanning a wide array of lifestyles, forms, habitats, and sizes. Fungi are known to play a vital role as decomposers, symbionts of plants and animals and as parasites of plants in different ecosystems. Fungi interact with their hosts, and also with abiotic variables in the environment. They occur on rocks, in soil, in sea and freshwater, in extreme habitats, experiencing high and low temperature, on dry substrates and in concentrated nutrients.

Since the first description of symbiosis as 'the living together of dissimilar organisms' (De Bary, 1879), an array of symbiotic lifestyles have been defined based on fitness benefits or impacts to macroscopic hosts and microscopic symbionts (Lewis, 1985). Collectively, more than 100 yr of research suggests that most, if not all, plants in natural ecosystems are symbiotic with mycorrhizal fungi and/or fungal endophytes (Petrini, 1986). These fungal symbionts can have profound effects on plant ecology, fitness, and evolution (Brundrett, 2006), shaping plant communities (Clay & Holah, 1999) and manifesting strong effects on the community structure and diversity of associated organisms (Omacini et al., 2001).

The fossil record indicates that plants have been associated with endophytic (Krings et al., 2007) and mycorrhizal (Redecker et al., 2000) fungi for > 400 Myr and were likely associated when plants colonized land, thus playing a long and important role in driving the evolution of life on land. Unlike mycorrhizal fungi that colonize plant roots and grow into the rhizosphere, endophytes reside entirely within plant tissues and may grow within roots, stems and/or leaves, emerging to sporulate at plant or host-tissue senescence (Stone et al., 2004). In general, two major groups of endophytic fungi have been recognized previously, reflecting differences in evolutionary relatedness, taxonomy, plant hosts, and ecological functions.

Members of mucorales are considered as ruderals since they survive in soil as long as nutrients are available although they are not capable of degrading cellulose or lignin. Fungi like *Fusarium*, *Gliocladium*, *Penicillium* and *Trichoderma* are stress tolerant. Majority of fungi are mesophiles with maximum growth between 25 and 30°C (*Mucor mucedo*, *Mortierella*, *Penicillium chrysogenum*) however *Cylindrocarpon* sp., *Candida scottii* are cold tolerant (psychrotolerant) and can grow near 0°C; others are thermotolerant and grow above 40°C (*Rhizomucor*, *Thermomyces*, *Talaromyces*). Xerotolerant fungi can grow on dry material (*Aspergillus*, *Penicillium*) with low matric potential while osmotolerants grow at very low osmotic potential (*Pichia* sp.). Dung of herbivorous mammals harbours a large number of fungi, termed coprophiles, of which *Pilobolous*, *Ascobolus*.

Therefore, objective's of our study was to identify the fungi in the sample. To understand their biodiversity in that habitat and to detect the associations such as symbiosis or endophytism, parasitism and pathogenic relationship in the walking mango tree. By studying this, we could improve our understanding the biodiversity of their existence their adaptations and survival in that particular environment with dicot host.

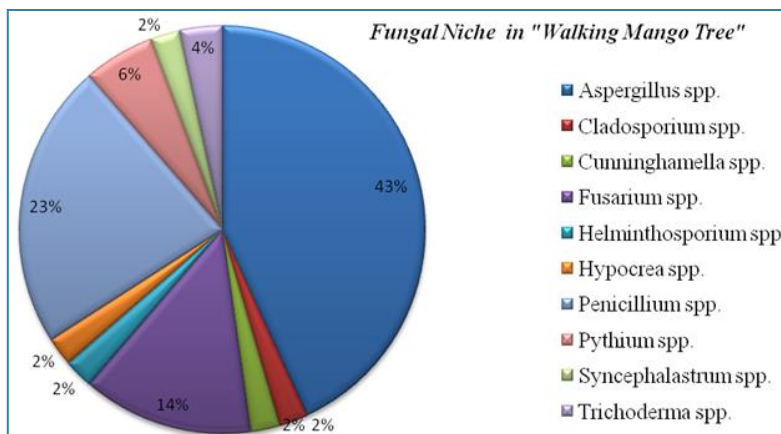
2. MATERIALS AND METHODS

2.1. Plant Material

The samples were collected from various parts of Walking Mango Tree and stored under 4°C for laboratory work. A voucher specimen was kept at Herbarium. It was ensured that the Samples were healthy and uninfected.

2.2. Biological Media

- Potato Dextrose Agar(PDA)
- Sabouraud Dextrose Agar
- Czapek's Dox



Graph 1

Fungal niche in "Walking Mango Tree"

- Martin Rose Bengal Agar (MRBA)

2.3. Method of testing

Standard protocols were followed for pure culture and Serial dilution method. Every 1ml of the solution was serially diluted into 10ml of sterile water. Later 1 ml of the solution was pipette out into the petriplates containing the fungal media. Each plate was wrapped with cling wrap to avoid any contamination and to maintain the pure colony growth. The plates were incubated around 25-30°C for their growth.

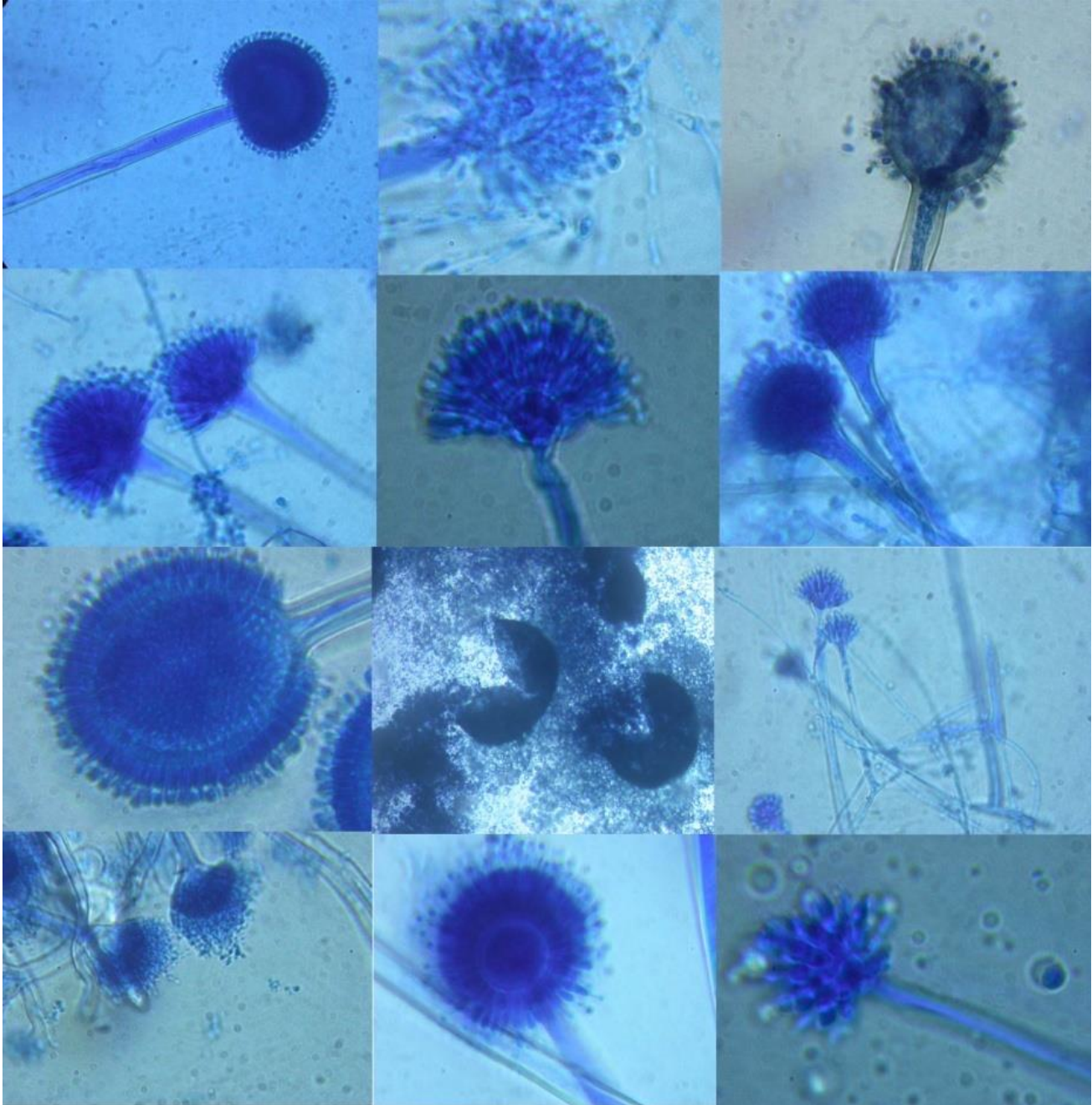


Figure 1-10 & 12

Aspergillus spp. (Left to right)

Figure 11

Cladosporium sp. (Left to right)

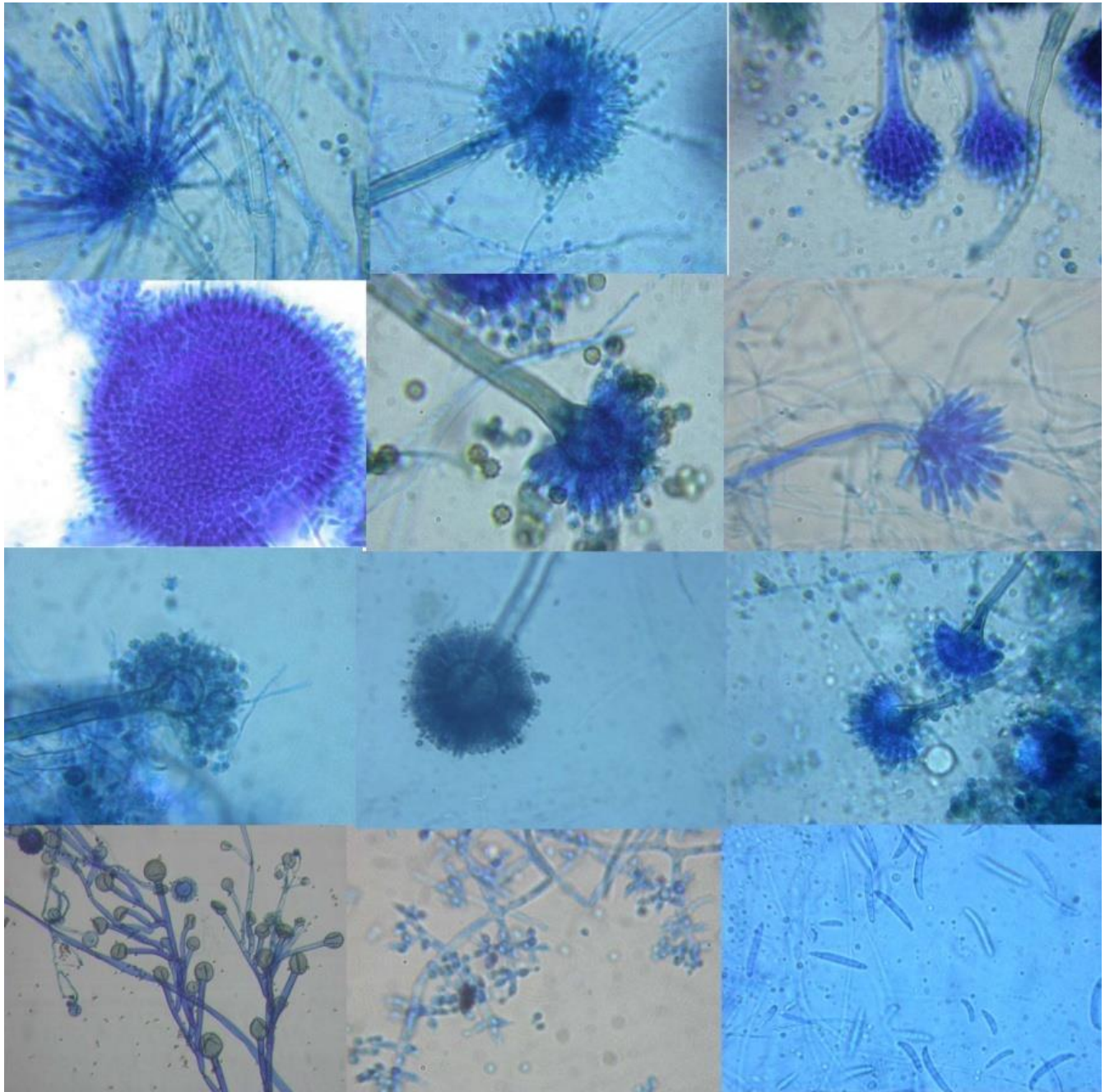


Figure 13-21

Aspergillus spp. (Left to right)

Figure 22

Cunninghamella sp. (Left to right)

Figure 23

Syncephalastrum sp. (Left to right)

Figure 24

Fusarium sp. (Left to right)

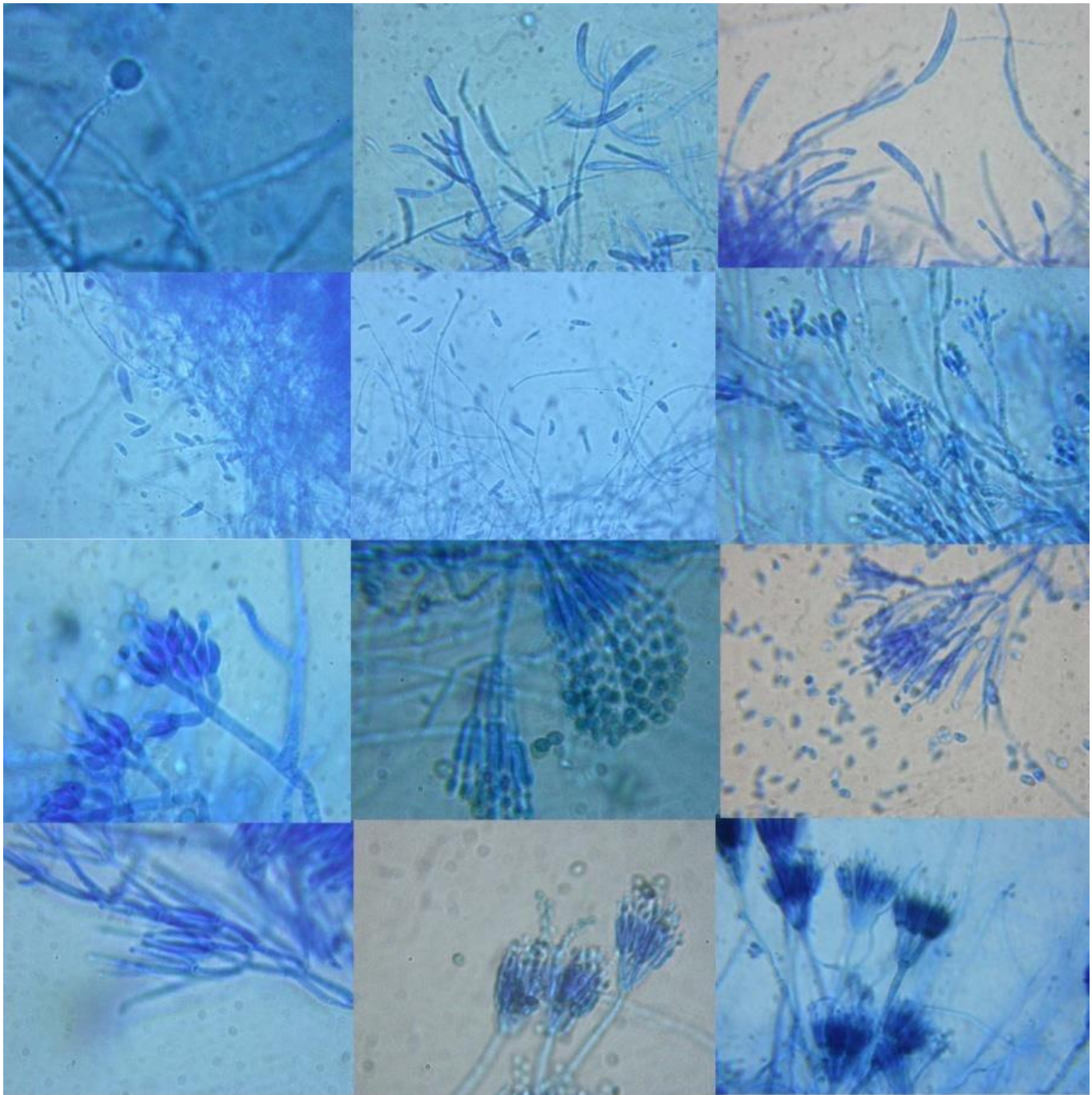


Figure 25

Pythium sp. (Left to right)

Figure 26-27

Fusarium spp. (Left to right)

Figure 28-29

Trichoderma spp. (Left to right)

Figure 30-36

Penicillium spp. (Left to right)

Table 1

List of *Aspergillus* species isolated

Specie isolated	Sample used							
	Bark	Soil In*	Soil Out*	Mango Fruit	Leaves	Sap	Stem	Seed
<i>Aspergillus. alliaceus</i>		+		+				
<i>A. atheciellus</i>			+		+		+	
<i>A. aureolatus</i>			+					+
<i>A. bicolor</i>		+	+					
<i>A. candidus</i>		+						
<i>A. carbonarius</i>		+	+					
<i>A. carneus</i>		+	+					
<i>A. clavatus</i>							+	
<i>A. elongatus</i>			+					
<i>A. flavipes</i>		+						
<i>A. flavus</i>	+	+			+		+	+
<i>A. fumigatus</i>			+			+		+
<i>A. glaucus</i>		+					+	
<i>A. japonicus</i>		+						
<i>A. melleus</i>			+					
<i>A. nidulans</i>		+			+			
<i>A. niger</i>	+	+	+	+	+			+
<i>A. niveus</i>		+						
<i>A. ochraceus</i>		+						
<i>A. oryzae</i>		+		+				
<i>A. penicillioides</i>			+					
<i>A. petrakii</i>		+	+					
<i>A. puniceus</i>		+						
<i>A. purpureus</i>						+		
<i>A. reptans</i>		+	+					
<i>A. restrictus</i>							+	
<i>A. sclerotiorum</i>			+					
<i>A. sojae</i>	+	+	+					+
<i>A. subsessilis</i>		+						
<i>A. sydowii</i>		+	+					
<i>A. tamarii</i>		+	+					
<i>A. terreus</i>		+	+			+		
<i>A. unguis</i>			+				+	
<i>A. ustus</i>		+						
<i>A. versicolor</i>		+	+					+
<i>A. ustus</i>		+						
<i>A. versicolor</i>		+	+					+
<i>A. warcupii</i>		+	+					+
<i>A. wentii</i>	+							

Table 2

List of *Cladosporium* species isolated

Specie isolated	Sample used							
	Bark	Soil In*	Soil Out*	Mango Fruit	Leaves	Sap	Stem	Seed
<i>Cladosporium herbarum</i>			+					
<i>C. cladosporioides</i>		+	+				+	

Table 3

List of *Cunninghamella* species isolated

Specie isolated	Sample used							
	Bark	Soil In*	Soil Out*	Mango Fruit	Leaves	Sap	Stem	Seed
<i>Cunninghamella elegans</i>				+				
<i>Cunninghamella echinulate</i>						+		

endophyte transmission (vertical or horizontal) is thought to significantly influence the evolution and sustainability of mutualisms. The mode of endophyte transmission alone does not dictate the outcome of symbioses but it may well influence the fitness benefits conferred by endophytes, the longevity of symbiotic associations, and the vulnerability of hosts to non-mutualistic endophytes. Nature represents a formidable pool of bioactive compounds and is more

3. RESULTS & DISCUSSION

The observed result has been recorded in the form of tables 1-7, graph 1 and in figures 1-36. It is generally accepted that only about 7 % of all fungi have so far been discovered, and about 93 % still wait to be discovered. Fungi are neglected organisms and they are not well protected, but like animals and plants, they are endangered by human activities. Although the 1992 Convention on Biological diversity extends protection to all groups of organisms, it is worded in terms of “animals, plants and microorganisms” and fungi do not fit well into these categories. Fungal endophytes comprise a diverse group of species that vary in symbiotic and ecological functions. Regardless, it is clear that these fungi can have profound impacts on the survival and fitness of plants in all terrestrial ecosystems, and therefore likely play a significant role in plant biogeography, evolution and community structure. These data can feed directly into studies of the systematics and taxonomy of these little-known fungi.

In addition, as we learn more about the contribution of endophytes to plant gene expression, it will be possible to profile gene expression patterns to assess the symbiotic status of plant communities. Ultimately it should be possible to determine the community structure and metabolic activity of all fungal symbionts associated with plants across landscapes. This may allow the development of new tools to assess changes in ecosystems resulting from natural fluctuations, climate change, and other anthropogenic features of environmental modification. Our limited understanding of such important microorganisms is a testament to the fact that the ‘age of discovery’ is just beginning. Until we understand more about the significance of endophytes in plant biology, our understanding of plant community dynamics and ecosystem function will be limited. It is important to point out that individual plants comprise communities of microorganisms including fungi, bacteria, viruses and sometimes algae.

More extensive characterization of different endophyte–plant associations may also provide greater insight into the evolution of mutualisms. For example, the mode of

Table 4List of *Fusarium* species isolated

Specie isolated	Sample used							
	Bark	Soil In*	Soil Out*	Mango Fruit	Leaves	Sap	Stem	Seed
<i>Fusarium aquaeductum</i>			+				+	+
<i>F. chlamydosporum</i>	+							
<i>F. dimerum</i>			+			+		
<i>F. fujikuroi</i>	+							
<i>F. subglutinans</i>		+	+					
<i>F. incarnatum</i>		+						
<i>F. orthoceras</i>		+						
<i>F. oxysporum</i>		+						
<i>F. proliferatum</i>	+							+
<i>F. solani</i>			+					
<i>F. tricinctum</i>			+			+		
<i>F. verticillioides</i>	+							

Table 5List of *Penicillium* species isolated

Specie isolated	Sample used							
	Bark	Soil In*	Soil Out*	Mango Fruit	Leaves	Sap	Stem	Seed
<i>Penicillium albocoremium</i>	+							
<i>P. allii</i>		+						
<i>P. amaliae</i>		+						
<i>P. camemberti</i>						+		
<i>P. chrysogenum</i>			+					
<i>P. citreonigrum</i>		+						
<i>P. cyclopium</i>			+					
<i>P. decumbens</i>		+	+				+	
<i>P. expansum</i>		+						
<i>P. glabrum</i>			+					
<i>P. ochrochloron</i>		+	+					
<i>P. italicum</i>		+				+		
<i>P. lanosum</i>			+					
<i>P. macrosporeum</i>		+	+					
<i>P. marneffei</i>				+				
<i>P. oxalicum</i>	+							+
<i>P. purpurogenum</i>		+						
<i>P. roqueforti</i>		+						
<i>P. rubens</i>			+					
<i>P. spinulosum</i>		+						

Table 6List of *Pythium* species isolated

Specie isolated	Sample used							
	Bark	Soil In*	Soil Out*	Mango Fruit	Leaves	Sap	Stem	Seed
<i>Pythium aphanidermatum</i>	+	+	+		+			+
<i>Pythium mamillatum</i>							+	
<i>Pythium sylvaticum</i>			+					
<i>Pythium torulosum</i>							+	+
<i>Pythium myriotylum</i>			+					

Table 7List of *Syncephalastrum* species isolated

Specie isolated	Sample used							
	Bark	Soil In*	Soil Out*	Mango Fruit	Leaves	Sap	Stem	Seed
<i>Syncephalastrum racemosum</i>				+				
<i>S. elegans</i>						+		

Table 8List of *Trichoderma* species isolated

Specie isolated	Sample used							
	Bark	Soil In*	Soil Out*	Mango Fruit	Leaves	Sap	Stem	Seed
<i>Trichoderma atroviride</i>		+	+					
<i>T. hamatum</i>	+							
<i>T. longibrachiatum</i>			+					+

than ever a strategic source for new and successful commercial products. Recent advances made in genomics, proteomics and combinatorial chemistry show that nature maintains compounds that have already the essence of bioactivity or function within the host and in the environment. Microbial sources such as fungi are well recognized to produce a wide variety of chemical structures, several of which are most valuable pharmaceuticals, agrochemicals and industrial products. The adaptation of these fungal species with respect to walking mango tree reveals that this tree is highly acidic in nature, though this tree is situated nearby to coasted area and the soil is alkaline.

From the above tabulated results we can say that *Aspergillus spp.* is grown predominately growing than other species, since it occupies 38% of its population than any other species. *Penicillium spp.* occupies 20% of its total population in this tree whereas the rest of the fungal species occupy less than 15% of their total population in this tree. From this we can understand why the stem grafting and seed germinating is not successful. The fungi present in tree are highly adapted to every part of this tree. But when any part is collected/ taken for further work, the fungi gets activated and starts to rotten the sample within 2 days. That's why the fruit rotten within 2 days when plucked from this tree. The stem grafting is not successful, because the activity of fungi is very fast and doesn't allow the stem to complete its process. Even when we try to sow the seed, we observe that after 2 days of sowing the seed into the soil, the fungi starts to grow inside the seed and decays the entire seed. Even the ripen fruit when plucked directly from the tree also rotten after 2 days. All the above problems are faced due to fungal activity. If the activity of the fungi is controlled, the stem grafting and seed germinating will exhibit some positive results. Though the fungi can be treated with fungicide, but the effect of fungicide on the stem may exhibit some variations. That's why Walking Mango Tree is unique. Understanding its biodiversity is a herculean task.

SUMMARY OF THE RESEARCH

This study reveals the presence of a fungi present in this tree. Their Endophytic association's needs to be further studied. Their manifestation in this highly acidic environment also needs to be worked out.

FUTURE ISSUES

These fungi provide a fascinating and almost endless source of biological diversity, which is a rich source for exploitation. By inhibiting the activities of these fungi in this tree would solve the problem of grafting.

DISCLOSURE STATEMENT

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